

Sheldrake, Sean

From: Pradeep Mugunthan <pmugunthan@anchorqea.com>
Sent: Tuesday, December 01, 2015 1:47 PM
To: Dana Bayuk; myron.burr@siltronic.com; DeMaria, Eva
Cc: Bob Wyatt; Patty Dost; John Edwards; Mike Riley; Miao Zhang; Binglei Gong; John Renda; Ben Hung; Carl Stivers; Rob Ede; 'James Peale'; 'Mike Murray'; Sheldrake, Sean; Peterson, Lance; Gamache, Matthew; LARSEN Henning; Jen Woronets; Sarah Riddle
Subject: RE: Gasco Model Workshop - Agenda
Attachments: Gasco Groundwater Model Workshop - Agenda.pdf

Hi Dana,

I am forwarding the email with agenda again to include Myron Burr, Eva DeMaria, Jen Woronets and Sarah Riddle. I missed them on the original distribution list.

Thanks.
Pradeep

Sent from my Verizon Wireless 4G LTE smartphone

----- Original message -----

From: Pradeep Mugunthan <pmugunthan@anchorqea.com>
Date: 25/11/2015 6:32 PM (GMT-06:00)
To: BAYUK Dana <BAYUK.Dana@deq.state.or.us>
Cc: Bob Wyatt <rjw@nwnatural.com>, Patty Dost <pdost@pearllegalgroup.com>, John Edwards <jedwards@anchorqea.com>, Mike Riley <mriley@anchorqea.com>, Miao Zhang <mzhang@anchorqea.com>, Binglei Gong <bgong@anchorqea.com>, John Renda <jrenda@anchorqea.com>, Ben Hung <bhung@anchorqea.com>, Carl Stivers <cstivers@anchorqea.com>, Rob Ede <robe@hahnenv.com>, 'James Peale' <jpeale@maulfoster.com>, 'Mike Murray' <mmurray@maulfoster.com>, Sean Sheldrake <sheldrake.sean@epa.gov>, "Peterson, Lance" <PetersonLE@cdmsmith.com>, "Gamache, Matthew" <GamacheM@cdmsmith.com>, LARSEN Henning <LARSEN.Henning@deq.state.or.us>
Subject: RE: Gasco Model Workshop - Agenda

Dana,

I also meant to ask in my e-mail below if DEQ is planning to present any material or wish to add anything to agenda. If you are please let me know and I will send out a revised agenda.

Thanks.
Pradeep

Pradeep Mugunthan, Ph.D., P.E.
ANCHOR QEA, LLC

Please note new contact information below D 773-857-1311 M 607-351-3494 www.anchorqea.com<<http://www.anchorqea.com>>

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-----Original Message-----

From: Pradeep Mugunthan

Sent: Wednesday, November 25, 2015 6:03 PM

To: 'BAYUK Dana' <BAYUK.Dana@deq.state.or.us>

Cc: Bob Wyatt <rjw@nwnatural.com>; Patty Dost <pdost@pearllegalgroup.com>; John Edwards <jedwards@anchorqea.com>; Mike Riley <mriley@anchorqea.com>; Miao Zhang <mzhang@anchorqea.com>; Binglei Gong <bgong@anchorqea.com>; John Renda <jrenda@anchorqea.com>; Ben Hung <bhung@anchorqea.com>; Carl Stivers <cstivers@anchorqea.com>; Rob Ede <robe@hahnenv.com>; 'James Peale' <jpeale@maulfoster.com>; 'Mike Murray' <mmurray@maulfoster.com>; Sean Sheldrake <sheldrake.sean@epa.gov>; Peterson, Lance <PetersonLE@cdmsmith.com>; Gamache, Matthew <GamacheM@cdmsmith.com>; LARSEN Henning <LARSEN.Henning@deq.state.or.us>

Subject: Gasco Model Workshop - Agenda

Dana,

Thanks for summarizing the issues in your e-mail below. Our preparation is along these lines and we hope to have a productive workshop. We have prepared an outline of the discussion items we anticipate (attached to this e-mail). Look forward to our discussions next week.

Hope you have a great holiday weekend as well.

Thanks.

Pradeep

Pradeep Mugunthan, Ph.D., P.E.

ANCHOR QEA, LLC

Please note new contact information below D 773-857-1311 M 607-351-3494 www.anchorqea.com<<http://www.anchorqea.com>> Please consider the environment before printing this email.

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-----Original Message-----

From: BAYUK Dana [mailto:BAYUK.Dana@deq.state.or.us]

Sent: Wednesday, November 25, 2015 5:10 PM

To: Pradeep Mugunthan <pmugunthan@anchorqea.com>

Cc: Bob Wyatt <rjw@nwnatural.com>; Patty Dost <pdost@pearllegalgroup.com>; John Edwards <jedwards@anchorqea.com>; Mike Riley <mriley@anchorqea.com>; Miao Zhang <mzhang@anchorqea.com>; Binglei Gong <bgong@anchorqea.com>; John Renda <jrenda@anchorqea.com>; Ben Hung <bhung@anchorqea.com>; Carl Stivers <cstivers@anchorqea.com>; Rob Ede <robe@hahnenv.com>; 'James Peale' <jpeale@maulfoster.com>; 'Mike Murray' <mmurray@maulfoster.com>; Sean Sheldrake <sheldrake.sean@epa.gov>; Peterson, Lance <PetersonLE@cdmsmith.com>; Gamache, Matthew <GamacheM@cdmsmith.com>; LARSEN Henning <LARSEN.Henning@deq.state.or.us>

Subject: RE: Gasco Monthly Technical Source Control Call - Presentation for Today's Call

Good afternoon Pradeep.

DEQ reviewed tables 1 and 2 attached to your November 3rd e-mail (see below). We appreciate you completing the tables and for arranging next Wednesday's (12/2) workshop. We're anticipating that the focus of the workshop will be on discussing some or all of the items listed on Page 7 of Anchor's September 2, 2015 Memorandum. The 9/2 Memorandum responds to DEQ's June 26th comments on NW Natural's June 15th model presentation.

I wanted to let you know that based on our review of the 11/3 tables, DEQ's primary interest for the workshop is to discuss the implications of the information in Table 1 on model simulations. Table 1 supports DEQ's conclusion that the amount of groundwater entering the model along the upgradient boundary is underestimated.

DEQ believes the amount and vertical distribution of groundwater entering the model to be fundamental aspects of the hydrogeologic conceptual site model. Consequently, they are also important factors for developing the groundwater model.

Based on the current status of the groundwater model, DEQ considers the groundwater flux rate into the upgradient model boundary to be the key factor needing resolution for model calibration. In particular, DEQ believes the basalt no-flow boundary limits the use of the model. DEQ concludes that adding a component of groundwater flux into the Alluvium WBZ from the basalt is more representative of site conditions, and that adding flux from the basalt should be made an integral aspect of the model.

Consistent with our previous communications, DEQ continues to conclude that under-representing flow into the uplands model boundary makes the model non-conservative for purposes of evaluating the performance and effectiveness of the HC&C system for uplands groundwater source control and for planning and designing the in-water sediment project.

We hope that next week's workshop will provide a forum for those most knowledgeable about the model to discuss groundwater flux along the upgradient boundary and identify a path forward for model development and calibration.

Have a good holiday Pradeep and feel free to call me with questions regarding this e-mail.

Dana

Mr. Dana Bayuk

Cleanup Program Project Manager/Hydrogeologist Oregon Department of Environmental Quality Northwest Region
700 NE Multnomah Street, Suite 600
Portland, OR 97232-4100

E-mail: bayuk.dana@deq.state.or.us<<https://deqmail.deq.state.or.us/owa/redir.aspx?C=xpW59Hf5PUaZQh14CmQiIBhMMhcOKtAICv8HjAWBmf41qjKIUXf-S2Jkwgyvoh92WdxoWiGazVI.&URL=mailto%3abayuk.dana%40deq.state.or.us>>

Phone: 503-229-5543

FAX: 503-229-6899

Please visit our website at

<http://www.oregon.gov/DEQ/><<https://deqmail.deq.state.or.us/owa/redir.aspx?C=xpW59Hf5PUaZQh14CmQiIBhMMhcOKtAICv8HjAWBmf41qjKIUXf-S2Jkwgyvoh92WdxoWiGazVI.&URL=http%3a%2f%2fwww.oregon.gov%2fDEQ%2f>>

From: Pradeep Mugunthan [mailto:pmugunthan@anchorqea.com]

Sent: Tuesday, November 03, 2015 7:20 AM

To: BAYUK Dana

Cc: Bob Wyatt; Patty Dost; John Edwards; Mike Riley; Miao Zhang; Binglei Gong; John Renda; Ben Hung; Carl Stivers; Rob Ede; 'James Peale'; 'Mike Murray'; Sean Sheldrake; Peterson, Lance; Gamache, Matthew; LARSEN Henning

Subject: RE: Gasco Monthly Technical Source Control Call - Presentation for Today's Call

Dana,

Attached please find the completed tables with the information you requested. As discussed over the phone a couple of weeks back we have left some columns shown blank (shown in gray). We look forward to discussing these results and other analyses at the workshop. Can you propose a few candidate dates the week of 23rd and week of 30th that would work for DEQ and CDM Smith?

Please let me know if you have any questions or need clarifications. Please note that I am (b) (6) and won't be available over the phone, but can respond to emails within a day.

Thanks.

Pradeep

Pradeep Mugunthan, Ph.D., P.E.

ANCHOR QEA, LLC

Please note new contact information below D 773-857-1311 M 607-351-3494 www.anchorqea.com<<http://www.anchorqea.com/>>

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From: BAYUK Dana [mailto:BAYUK.Dana@deq.state.or.us]

Sent: Tuesday, October 06, 2015 6:29 PM

To: Pradeep Mugunthan <pmugunthan@anchorqea.com<mailto:pmugunthan@anchorqea.com>>

Cc: Bob Wyatt <rjw@nwnatural.com<mailto:rjw@nwnatural.com>>; Patty Dost <pdost@pearllegalgroup.com<mailto:pdost@pearllegalgroup.com>>; John Edwards <jedwards@anchorqea.com<mailto:jedwards@anchorqea.com>>; Mike Riley <mriley@anchorqea.com<mailto:mriley@anchorqea.com>>; Miao Zhang <mzhang@anchorqea.com<mailto:mzhang@anchorqea.com>>; Binglei Gong <bgong@anchorqea.com<mailto:bgong@anchorqea.com>>; John Renda <jrenda@anchorqea.com<mailto:jrenda@anchorqea.com>>; Ben Hung <bhung@anchorqea.com<mailto:bhung@anchorqea.com>>; Carl Stivers <cstivers@anchorqea.com<mailto:cstivers@anchorqea.com>>; Rob Ede <robe@hahnenv.com<mailto:robe@hahnenv.com>>; 'James Peale' <jpeale@maulfoster.com<mailto:jpeale@maulfoster.com>>; 'Mike Murray' <mmurray@maulfoster.com<mailto:mmurray@maulfoster.com>>; Sean Sheldrake <sheldrake.sean@epa.gov<mailto:sheldrake.sean@epa.gov>>; Peterson, Lance <PetersonLE@cdmsmith.com<mailto:PetersonLE@cdmsmith.com>>; Gamache, Matthew <GamacheM@cdmsmith.com<mailto:GamacheM@cdmsmith.com>>; LARSEN Henning <LARSEN.Henning@deq.state.or.us<mailto:LARSEN.Henning@deq.state.or.us>>

Subject: RE: Gasco Monthly Technical Source Control Call - Presentation for Today's Call

Good afternoon Pradeep.

DEQ reviewed NW Natural's September 2, 2015 technical memorandum responding to our comments on the June 15, 2015 groundwater model presentation materials. DEQ issued our comments on June 26, 2015 by e-mail (see below). DEQ's June 26th e-mail did not approve model calibration and/or moving forward with sensitivity analyses.

Based on our review of the September 2nd memorandum and attachment, DEQ concludes our June 26th comments have not been addressed. Furthermore, the September 2nd response did not alter our overall position on the current version of the model. Our position on the model continues to be that the parameter inputs and fundamental hydrogeologic CSM of the model are non-conservative for purposes of simulating uplands groundwater conditions and/or for use in planning the in-water sediment project. As currently constructed the model underestimates groundwater flux along the southwestern (upgradient) boundary, which increases the relative contribution of water to the HC&C system from under the Willamette River. In addition, the model overestimates the influence of the HC&C system on the Fill WBZ in certain areas along the shoreline.

The purpose of this e-mail is to request additional documentation specific to the Gasco Site model that DEQ considers necessary for our review of NW Natural's modeling approach.

DEQ's reply to NW Natural's September 2nd response is provided below. EPA reviewed the e-mail, concurs with the content, and agrees with DEQ's determinations regarding NW Natural's responses.

NW Natural's Responses and DEQ's Replies

DEQ has identified groundwater flux into the upgradient model boundary, recharge by rainfall to the Fill WBZ, and shoreline K-value assignments in certain portions of the Fill WBZ as the priority items requiring resolution. In addition, DEQ clarifies our comment on upland K-value assignments. Although not considered a priority, the K-value comment provides an additional example of the non-conservative approach used for model development.

NW Natural's summary of each response to DEQ's comment on each of these items is cut-and-pasted below and shown in italics. DEQ's reply follows.

"The predicted flow rates in the USGS model should not be used as data that constrain the Gasco model boundary conditions (see Attachment A)."

NW Natural's response is not applicable. Our comments did not indicate that NW Natural should use the USGS Regional Groundwater Model (USGS Model) to establish the boundary conditions for the upgradient (western) boundary of the Gasco groundwater model. DEQ cites information in the USGS Model to support our conclusions that the current version of the Gasco model underestimates groundwater flux into the model domain. DEQ considers the USGS Model and supporting documentation to be an important line of evidence supporting our conclusions. Other lines of evidence include NW Natural's assumption that groundwater flux into the model is restricted to the upper Alluvium WBZ, and assigning no-flow to the basalt.

The discrepancies between the USGS-estimated recharge to the area upgradient of the Gasco groundwater model boundary and the flows being simulated across the Gasco groundwater model boundary require documentation.

DEQ requires NW Natural to complete the attached Table 1 with information for the Gasco Site model. DEQ continues to maintain that increasing groundwater flux by 300-500 gpm into the Gasco model along the uplands boundary is a reasonably conservative approach.

"Following the approach for developing recharge rates in the Gasco area of the USGS model, a recharge rate of 11 inches per year may be justified (see Attachment A)."

Although DEQ considers 11-inches to be a more reasonable estimate of recharge, the recharge rates used in the model, as they apply to various types of surfaces within the model domain, need to be fully documented for DEQ to complete our review of the model.

DEQ requires that NW Natural complete the attached Table 2 with information for the Gasco Site model.

Unless NW Natural fully documents the components of recharge and recharge to the water table as indicated above, DEQ cannot complete our review. Lacking documentation of an acceptable alternative, DEQ continues to maintain that a value of 20-inches/year is a reasonably conservative estimate for modeling purposes.

"Additional analyses demonstrated that the transient hydraulic influence of the HC&C system on the Fill WBZ is minimal and that the hydraulic connection between the Fill WBZ and Upper Alluvium WBZ is limited in the model (see Figures 4a through 4d). However, long-term operation of the HC&C system could result in additional significant water level declines in the Fill WBZ."

NW Natural's response is not accepted. DEQ's comment refers to the influence of the HC&C system on the Fill WBZ during steady-state model simulations (i.e., long-term operations). NW Natural's response compares simulated water level trends for the Phase 1 Step 6 test (approximately a week). NW Natural's

response acknowledges that, “These findings are limited to the Phase 1, Step 6 simulation period and are not reflective of the long-term effects of the HC&C system operation, which could cause a larger decline in the Fill WBZ water levels.”

There are good reasons to believe the very dynamic groundwater regime that dominates the upland-surface water interface will not reach a long-term steady-state condition. The HC&C system began full-scale operations at maintenance flows (100-150 gpm) in September 2013. The system operated full-scale full-time without discharge limitations for 30-days earlier this year. Based on the data collected from instrumented wells during these operational periods, groundwater in the Fill WBZ is not influenced by the HC&C system. DEQ’s conclusion considers available data and data evaluation completed to date, including Siltronic’s Fill WBZ Evaluation Supplement (see footnote).

DEQ position remains unchanged on this topic. For purposes of making the model reasonably conservative, DEQ directs NW Natural to modify the model so areas where the silt unit is thin or absent are assigned horizontal and vertical K-values representative of the silt until such time the data indicate otherwise.

“The K values currently assigned in the model were obtained from model calibration under a range of pumping and non-pumping conditions for a large number of wells and are consistent with the step test results at shoreline wells (see Figures 1 through 3).”

For clarification, DEQ’s comment did not question whether K-values were selected from within a range of available values for a particular WBZ. The comment was intended to: 1) be used in conjunction with our comments on recharge to the Fill WBZ and Alluvium WBZ and groundwater flux into the model; and 2) compare and contrast K-value assignments and the areas of the model occupied by those assignments. DEQ concludes from reviewing the June 15th presentation materials and September 2nd response that NW Natural’s upper Alluvium WBZ K-value assignments in the uplands, assumptions regarding groundwater flux into the model via the upper Alluvium WBZ, estimate of groundwater flux through the uplands boundary into the model domain, and assigning no-flow to the basalt; operate together to reduce and restrict groundwater flux into the model from the uplands side. In addition, the higher K-values assigned to the lower Alluvium WBZ and deep lower Alluvium WBZ (20 to 150-times the upper Alluvium WBZ) increase the likelihood that the HC&C system will draw water from under the river, especially during longer pumping periods.

Overall this combination of modeling parameters results in the model being non-conservative.

Proposed Path Forward

DEQ agrees that a workshop is a useful way to further evaluate DEQ’s concerns regarding the current version of the Gasco Site groundwater model. That said, DEQ considers the information requested above to be important for developing shared understandings of the current configuration of the model and its potential limitations prior to the workshop. Consequently, DEQ will review NW Natural’s written response to this e-mail before the workshop is scheduled.

Please feel free to contact me with questions regarding this e-mail.

Mr. Dana Bayuk

Cleanup Program Project Manager/Hydrogeologist Oregon Department of Environmental Quality Northwest Region

700 NE Multnomah Street, Suite 600

Portland, OR 97232-4100

E-mail: bayuk.dana@deq.state.or.us<mailto:bayuk.dana@deq.state.or.us>

Phone: 503-229-5543

FAX: 503-229-6945

Please visit our website at <http://www.oregon.gov/DEQ/>

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Footnote. Maul Foster and Alongi, Inc. 2015, "Supplement to Fill Water-Bearing Zone Groundwater Evaluation – Northern Portion of the Siltronic Corporation Property, Portland, Oregon ESCI No. 183," May 29, a technical memorandum prepared for Siltronic Corporation.

From: Pradeep Mugunthan [mailto:pmugunthan@anchorqea.com]

Sent: Wednesday, September 02, 2015 4:32 PM

To: BAYUK Dana

Cc: Sean Sheldrake; 'Peterson, Lance'; Coffey, Scott; Gamache, Matthew; LARSEN Henning; John Edwards; Mike Riley; Miao Zhang; Binglei Gong; John Renda; Ben Hung; Carl Stivers; Rob Ede; 'James Peale'; 'Mike Murray'; Bob Wyatt; Patty Dost; Sarah Riddle

Subject: RE: Gasco Monthly Technical Source Control Call - Presentation for Today's Call

Dana,

Attached please find a technical memorandum documenting our responses to DEQ's comments on June 15 modeling presentation (e-mail below). As indicated in the memo, we are proposing a workshop with DEQ and EPA to review specific tasks proposed in the memo in greater detail. I will reach out to you regarding candidate dates for the workshop which we are hoping can be scheduled within the next few weeks.

Thanks.

Pradeep

Pradeep Mugunthan, Ph.D., P.E.

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D 415-361-5151

www.anchorqea.com<<http://www.anchorqea.com/>>

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From: BAYUK Dana [mailto:BAYUK.Dana@deq.state.or.us]

Sent: Friday, June 26, 2015 1:13 PM

To: Pradeep Mugunthan <pmugunthan@anchorqea.com<mailto:pmugunthan@anchorqea.com>>

Cc: John Edwards <jedwards@anchorqea.com<mailto:jedwards@anchorqea.com>>; Binglei Gong <bgong@anchorqea.com<mailto:bgong@anchorqea.com>>; Ben Hung <bhung@anchorqea.com<mailto:bhung@anchorqea.com>>; John Renda <jrenda@anchorqea.com<mailto:jrenda@anchorqea.com>>; Mike Riley <mriley@anchorqea.com<mailto:mriley@anchorqea.com>>; Carl Stivers <cstivers@anchorqea.com<mailto:cstivers@anchorqea.com>>; Rob Ede <robe@hahnenv.com<mailto:robe@hahnenv.com>>; 'James Peale' <jpeale@maulfoster.com<mailto:jpeale@maulfoster.com>>; 'Mike Murray' <mmurray@maulfoster.com<mailto:mmurray@maulfoster.com>>; Sean Sheldrake <sheldrake.sean@epa.gov<mailto:sheldrake.sean@epa.gov>>; 'Peterson, Lance' <PetersonLE@cdmsmith.com<mailto:PetersonLE@cdmsmith.com>>; Coffey, Scott <CoffeySE@cdmsmith.com<mailto:CoffeySE@cdmsmith.com>>; Gamache, Matthew <GamacheM@cdmsmith.com<mailto:GamacheM@cdmsmith.com>>; LARSEN Henning <LARSEN.Henning@deq.state.or.us<mailto:LARSEN.Henning@deq.state.or.us>>
Subject: RE: Gasco Monthly Technical Source Control Call - Presentation for Today's Call

Hello Pradeep.

DEQ reviewed the model update presentation materials that Anchor provided on June 15, 2015. The materials provide DEQ and EPA with an update on the status of groundwater modeling work completed since the previous update on April 20, 2015. The June 15th presentation substantially expands on previous presentations and much of the presentation consists of information provided for the first time.

Slide #57 of the June 15th presentation summarizes the status and proposed next steps in the modeling process. Based on the slide and discussions during the presentation, DEQ understands that NW Natural:

- Concludes that model calibration is complete for the Alluvium WBZs;
- Recommends proceeding to the model sensitivity analysis and validation (validation using Phase 1, Step 5 data) ;
- Is developing particle tracking simulations to assess system performance during Phase 1 and Phase 2 testing;
- Proposes refining the model for the Fill WBZ using a seepage face approach; and
- Proposes beginning the report documenting the model.

During the June 15th discussions we agreed that:

- DEQ's approval was needed on the first two items in the list above;
- DEQ's approval was not needed for the third item as the particle tracks are functionally a part of the model; and
- Anchor should proceed with incorporating the seepage face approach for the Fill WBZ into the model.

Report preparation was not specifically discussed on June 15th.

Regarding the first two items in the list, the primary purpose of this e-mail is to inform NW Natural that based on the June 15th discussions and our review of the presentation materials, DEQ does not approve calibration of the Alluvium WBZs. Consequently, DEQ also does not approve moving forward with the sensitivity analyses and model validation.

DEQ is not approving calibration of the current version of the model primarily for the following reasons:

- The amount of precipitation recharging the Fill WBZ in the uplands portions of the model, and the rate of groundwater flow entering the model domain along the upgradient constant-head boundary appear to be significantly underestimated. The attached memorandum prepared by CDM Smith on behalf of EPA provides the technical basis for DEQ's conclusion. DEQ has reviewed the attachment and concurs with the conclusions presented.
- Hydraulic conductivity (K) assignments appear to restrict movement of groundwater from the uplands to shoreline extraction wells. DEQ observes that the uplands K-values in the Gasco groundwater model have been reduced significantly during the calibration process. For example, in the July 2013 version of the Model Update Report the horizontal K-value assignments in the Upper Alluvium WBZ, Lower Alluvium WBZ, and Deep Lower Alluvium WBZ ranged from 100 to 1,250 feet/day. Slides 40, 41, and 42 of the June 15th presentation now show the K-values assigned to these three WBZs as ranging from 3 to 15 feet/day (note that the 200/20 feet/day Zone 24 shown in Slide 42 is not relevant as it is largely outside the deep lower alluvium active zone). Currently the uplands K-values assigned to the Alluvium WBZs are significantly lower than:
 - Assignments near the river in the Gasco model;
 - Estimates based on extraction well tests (e.g., Lower Alluvium WBZ K-values are 20-30 times less than the geometric and/or arithmetic means derived from the tests); and
 - Values used in the USGS model.

DEQ concludes that reducing uplands K-values is indicative of the need to raise groundwater heads without increasing groundwater flow through the system. DEQ also concludes that the combination of underestimating recharge and the use of low-K values limits the amount of uplands groundwater available to the HC&C system. This combination of factors results in the model reaching out to and under the river to meet the demands of pumping the HC&C system extraction wells.

- The model over predicts the influence of the HC&C system on water levels in the Fill WBZ. DEQ concludes this is the result of placing unadjusted horizontal and vertical K-values for the Upper Alluvium WBZ directly below the fill where the "upper silt unit" is interpreted to be thin or absent. As a result, model simulations contradict data collected along the shoreline that indicate:
 - The hydraulic properties of the upper-most Alluvium WBZ beneath the upper silt unit and/or the Fill WBZ are lower than the upper Alluvium WBZ; and
 - There is limited hydraulic connection between the Fill WBZ and the Upper Alluvium WBZ, if any.

Based on Slide #53, DEQ believes this comment applies to portions of both the Gasco Site and the Siltronic Site.

In summary, DEQ does not approve the current version of the model for the following reasons:

- Underestimating recharge and groundwater flux in the uplands portions of the model necessitates the use of low K-values to calibrate heads in the Alluvium WBZs.
- The combination of underestimating recharge and using low-K values: 1) limits the amount of uplands groundwater available to the HC&C system; and 2) results in model simulations that show the HC&C system reaching out to and under river to meet the extraction rates.
- Model simulations over predict the hydraulic influence of the HC&C system on the Fill WBZ and contradict available information and data that indicate the hydraulic connection between the Fill WBZ and Upper Alluvium WBZ is limited.

The groundwater model is being used to evaluate the performance and effectiveness of the HC&C system for uplands groundwater source control. In addition, the model is being used for planning and designing the in-water sediment project. Given this information, it is important for model input parameters to be representative of conservative conditions based on available information, observations, and site data. In DEQ's view, underestimating recharge to the Fill WBZ and Alluvium WBZs, using low K-values in the uplands, and assumptions that indicate there is a hydraulic connection between the Fill WBZ and Alluvium WBZs make the model non-conservative overall.

Based on this information, DEQ believes that modifications to key parameters and model recalibration are warranted. Modifications to the model should include, but are not necessarily limited to the following:

- Groundwater flows along the upgradient constant head boundary should be increased by an additional minimum of 300-500 gpm. Uplands K-values in the Alluvium WBZs should be increased accordingly to calibrate the model to the increase in recharge.
- Recharge to the Fill WBZ by precipitation in pervious areas should be increased to at least 20-inches per year.
- Areas within the model where the silt unit is thin or absent should use the horizontal and vertical K-values for the silt until such time as data is developed to indicate otherwise.

(b) (6) Please feel free to contact me to arrange a call to discuss this e-mail. I don't know the availability of the EPA team, but Henning and I are available next Tuesday (6/30) after 330pm and from 1-3pm on Wednesday (7/1) for a call.

Dana

Mr. Dana Bayuk

Cleanup Program Project Manager/Hydrogeologist Oregon Department of Environmental Quality Northwest Region
700 NE Multnomah Street, Suite 600
Portland, OR 97232-4100

E-mail: bayuk.dana@deq.state.or.us<mailto:bayuk.dana@deq.state.or.us>

Phone: 503-229-5543

FAX: 503-229-6945

Please visit our website at <http://www.oregon.gov/DEQ/>

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From: Pradeep Mugunthan [mailto:pmugunthan@anchorqea.com]

Sent: Monday, June 15, 2015 9:52 AM

To: BAYUK Dana; LARSEN Henning; Scott Coffey (coffeyse@cdmsmith.com<mailto:coffeyse@cdmsmith.com>); Lance Peterson

(PetersonLE@cdmsmith.com<mailto:PetersonLE@cdmsmith.com>); Matt Gamache (gamachem@cdmsmith.com<mailto:gamachem@cdmsmith.com>); Sean

Sheldrake; James Peale; mmurray@maulfoster.com<mailto:mmurray@maulfoster.com>; Mike Riley; John Edwards; John Renda; Ben Hung; Binglei Gong

Cc: Carl Stivers; Rob Ede; Bob Wyatt; Patty Dost; Sarah Riddle

Subject: Gasco Monthly Technical Source Control Call - Presentation for Today's Call

Dana,

As per your request we are sending the presentation ahead of our call this afternoon. Please forward to anyone I may have missed.

Thanks.

Pradeep

Pradeep Mugunthan, Ph.D., P.E.

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-----Original Appointment-----

From: Jen Woronets

Sent: Tuesday, June 02, 2015 1:46 PM

To: Jen Woronets; Dana Bayuk; larsen.henning@deq.state.or.us<mailto:larsen.henning@deq.state.or.us>; Scott Coffey (coffeyse@cdmsmith.com<mailto:coffeyse@cdmsmith.com>); Lance Peterson (PetersonLE@cdmsmith.com<mailto:PetersonLE@cdmsmith.com>); Matt Gamache (gamachem@cdmsmith.com<mailto:gamachem@cdmsmith.com>); Sean Sheldrake; James Peale; mmurray@maulfoster.com<mailto:mmurray@maulfoster.com>; Mike Riley; John Edwards; John Renda; Ben Hung; Pradeep Mugunthan; Binglei Gong
Cc: Carl Stivers; Rob Ede
Subject: Gasco Monthly Technical Source Control Call
When: Monday, June 15, 2015 1:30 PM-4:30 PM (UTC-08:00) Pacific Time (US & Canada).
Where: (b) (6) and web meeting

Dana, Henning, Scott, Lance, Matt, Sean, James, Mike M., Rob, Mike R., John E., John R., Ben, Carl, Pradeep -

Meeting information

Topic: Gasco Monthly Technical Source Control Call

Date: Monday, June 15, 2015

Time: 1:30 pm, Pacific Daylight Time (San Francisco, GMT-07:00) Meeting Number: 573 049 971 Meeting Password: (This meeting does not require a password.)

To start or join the online meeting

Go to (b) (6)

----- Audio conference information

To receive a call back, provide your phone number when you join the meeting, or call the number below and enter the access code.

Call-in toll-free number (US/Canada): (b) (6) Call-in toll number (US/Canada): (b) (6)

Access code (b) (6)

Toll-free dialing restrictions: (b) (6)

Pradeep will host this meeting.